TRANSMITTAL OF INFORMATION DISCLOSURE STATEMENT (Under 37 CFR 1.97(b) or 1.97(c))	Docket No. DE3-0089/DP-300793

14/IDS
Y. Smith
1/24/02

In Re Application Of: THADDEUS SCHRODER ET AL

Serial No.	Filing Date	Examiner	Group Art Unit
09/663,030	September 15, 2000	D. DePumpo	3611

Title: PIEZORESISTIVE TORQUE SENSOR

Address to:
Assistant Commissioner for Patents
Washington, D.C. 20231

37 CFR 1.97(b)

1. ☐ The Information Disclosure Statement submitted herewith is being filed within three months of the filing of a national application other than a continued prosecution application under 37 CFR 1.53(d); within three months of the date of entry of the national stage as set forth in 37 CFR 1.491 in an international application; before the mailing of a first Office Action on the merits, or before the mailing of a first Office Action after the filing of a request for continued examination under 37 CFR 1.114.

37 CFR 1.97(c)

2. ☒ The Information Disclosure Statement submitted herewith is being filed after the period specified in 37 CFR 1.97(b), provided that the Information Disclosure Statement is filed before the mailing date of a Final Action under 37 CFR 1.113, a Notice of Allowance under 37 CFR 1.311, or an Action that otherwise closes prosecution in the application, and is accompanied by one of:

   ☐ the statement specified in 37 CFR 1.97(e);

   OR

   ☒ the fee set forth in 37 CFR 1.17(p).

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PIEZORESISTIVE TORQUE SENSOR

Payment of Fee

(Only complete if Applicant elects to pay the fee set forth in 37 CFR 1.17(p))

☒ A check in the amount of **$180.00** is attached.

☒ The Assistant Commissioner is hereby authorized to charge and credit Deposit Account No. **06-1130** as described below. A duplicate copy of this sheet is enclosed.

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Dated:

George J. Lyman
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3611

CERTIFICATE OF MAILING BY FIRST CLASS MAIL (37 CFR 1.8) Applicant(s): SCHROEDER ET AL			Docket No. DE3-0089
Serial No. 09/663,030	Filing Date September 15, 2000	Examiner DePumpo	Group Art Unit 3611

Invention: **PIEZORESISTIVE TORQUE SENSOR**

I hereby certify that this **Information Disclosure Statement, Form PTO 1449 with copy of (1) cited reference**
(Identify type of correspondence)

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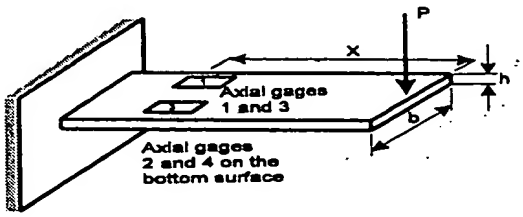

FIGURE 23.6 Beam-type load cells: (*a*) a selection of beam-type load cells (elastic element with strain gages) and (*b*) gage positions in the Wheatstone bridge [3].

Beam-Type Load Cell

Beam-type load cells are commonly employed for measuring low-level loads [3]. A simple cantilever beam (see Figure 23.6(*a*)) with four strain gages, two on the top surface and two on the bottom surface (all oriented along the axis of the beam) is used as the elastic member (sensor) for the load cell. The gages are wired into a Wheatstone bridge as shown in Figure 23.6(*b*). The load P produces a moment $M = Px$ at the gage location (x) that results in the following strains:

$$\varepsilon_1 = -\varepsilon_2 = \varepsilon_3 = -\varepsilon_4 = \frac{6M}{Ebh^2} = \frac{6Px}{Ebh^2} \tag{23.9}$$

where b is the width of the cross-section of the beam and h is the height of the cross-section of the beam. Thus, the response of the strain gages is obtained from Equation 23.10.

$$\frac{\Delta R_1}{R_1} = -\frac{\Delta R_2}{R_2} = \frac{\Delta R_3}{R_3} = -\frac{\Delta R_4}{R_4} = \frac{6S_g Px}{Ebh^2} \tag{23.10}$$

The output voltage E_o from the Wheatstone bridge, resulting from application of the load P, is obtained from Equation 23.11. If the four strain gages on the beam are assumed to be identical, then Equation 23.11 holds.

$$E_o = \frac{6S_g PxE_i}{Ebh^2} \tag{23.11}$$

The range and sensitivity of a beam-type load cell depends on the shape of the cross-section of the beam, the location of the point of application of the load, and the fatigue strength of the material from which the beam is fabricated.

Ring-Type Load Cell

Ring-type load cells incorporate a proving ring (see Figure 23.7) as the elastic element. The ring element can be designed to cover a very wide range of loads by varying the diameter D, the thickness t, or the depth w of the ring. Either strain gages or a linear variable-differential transformer (LVDT) can be used as the sensor.

The load P is linearly proportional to the output voltage E_o. The sensitivity of the ring-type load cell with an LVDT sensor depends on the geometry of the ring (R, t, and w), the material from which the ring is fabricated (E), and the characteristics of the LVDT (S and E_i). The range of a ring-type load cell is controlled by the strength of the material used in fabricating the ring.